



# 1.0 Introduction

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This Hanford Site environmental report is produced through the joint efforts of the principal site contractors (Pacific Northwest National Laboratory, Fluor Daniel Hanford, Inc. and its subcontractors, Bechtel Hanford, Inc. and its subcontractors, and MACTEC-ERS). This report, published annually since 1958, includes information and summary data that 1) characterize environmental management performance at the Hanford Site; 2) demonstrate the status of the site's compliance with applicable federal, state, and local environmental laws and regulations; and 3) highlight significant environmental monitoring and surveillance programs and projects.

Specifically, this report provides a short introduction to the Hanford Site and its history; discusses the site mission; and briefly highlights the site's various waste management, effluent monitoring, environmental surveillance, and environmental compliance programs and projects. Included are

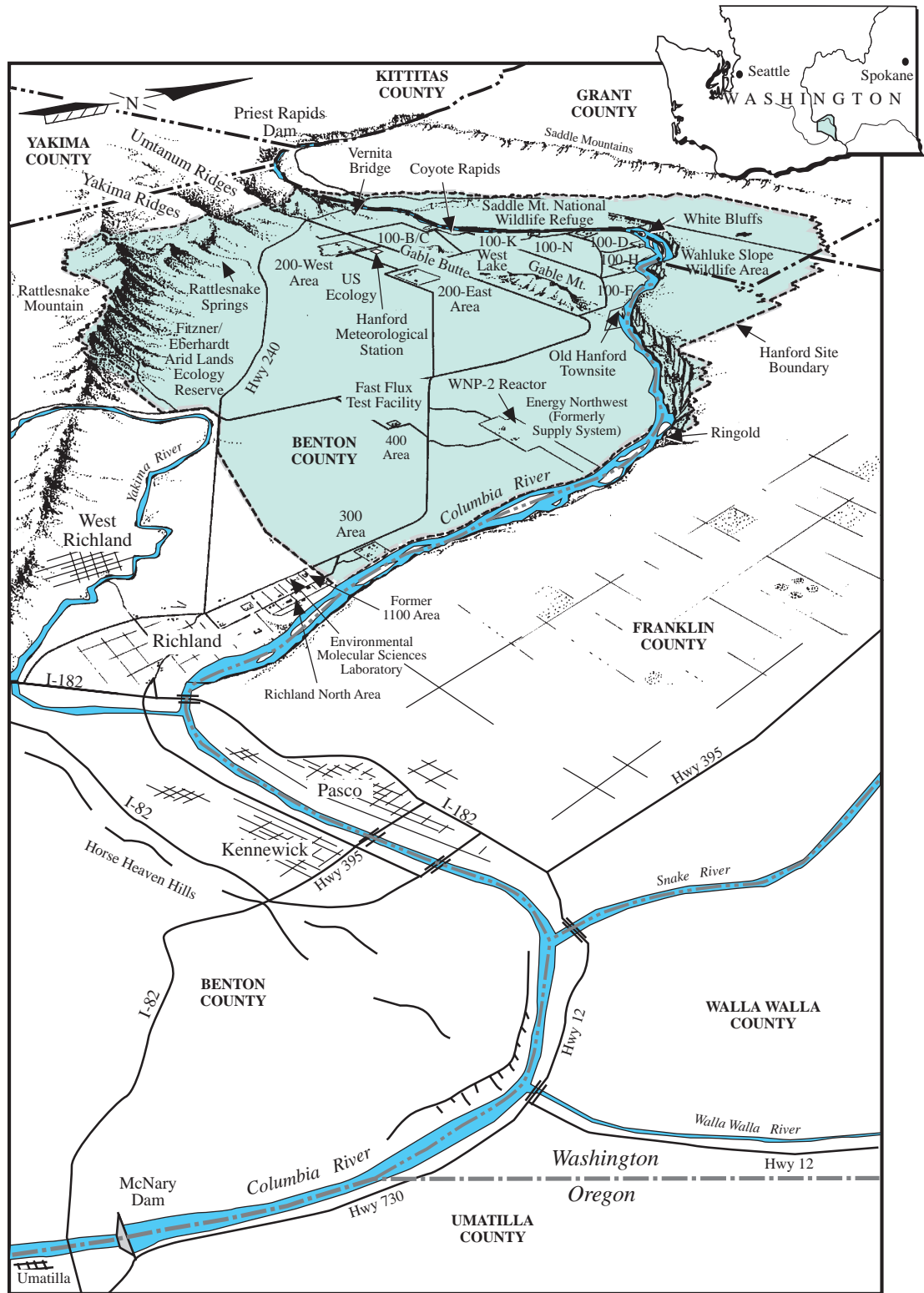
summary data and descriptions for the Hanford Site Groundwater/Vadose Zone Integration Project, the Near-Facility Environmental Monitoring Program, the Integrated Biological Control Program, the Surface Environmental Surveillance Project, the Hanford Groundwater Monitoring Project, the Hanford Cultural Resources Laboratory, wildlife studies, climate and meteorological monitoring, and information about other programs and projects. Also included are sections discussing environmental occurrences, current issues and actions, environmental cleanup activities, compliance issues, and descriptions of major operations and activities. Readers interested in more detail than that provided in this report should consult the technical documents cited in the text and listed in the reference sections. Descriptions of specific analytical and sampling methods used in the monitoring efforts are contained in the Hanford Site environmental monitoring plan (DOE/RL-91-50, Rev. 2).

## 1.0.1 Overview of the Hanford Site

The Hanford Site lies within the semiarid Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 1.0.1). The site occupies an area of approximately 1,450 km<sup>2</sup> (approximately 560 mi<sup>2</sup>) located north of the city of Richland and the confluence of the Yakima and Columbia Rivers. This large area has restricted public access and provides a buffer for the smaller areas on the site that historically were used for production of nuclear materials, waste storage, and waste disposal. Only approximately 6% of the land area has been disturbed and actively used. The Columbia River flows eastward through the northern part of the Hanford Site and then turns south, forming part of the eastern site boundary. The Yakima River flows near a portion of

the southern boundary and joins the Columbia River at the city of Richland.

The cities of Richland, Kennewick, and Pasco (Tri-Cities) constitute the nearest population centers and are located southeast of the site. Land in the surrounding environs is used for urban and industrial development, irrigated and dry-land farming, and grazing. In 1995, wheat represented the largest single crop in terms of area planted in Benton and Franklin Counties. Total area planted in the two counties was 100,770 and 18,810 ha (249,000 and 46,500 acres) for winter and spring wheat, respectively. Alfalfa, apples, asparagus, cherries, corn, grapes, and potatoes are other major crops in Benton and Franklin



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**Figure 1.0.1. The Hanford Site and Surrounding Area**



Counties. More than 20 food processors in Benton and Franklin Counties produce food products, including potato products, canned fruits and vegetables, wine, and animal feed.

In 1997, approximately 20% of the nonagricultural jobs in Benton and Franklin Counties were located at Hanford. An average of 11,140 employees were working on the site in 1997. Hanford's large portion of the Tri-Cities' employment has had an impact on other areas of employment, directly or indirectly accounting for >40% of all jobs in Benton and Franklin Counties.

Estimates for 1997 placed population totals for Benton and Franklin Counties at 134,100 and 43,900, respectively (Washington State Office of Financial Management 1997a). When compared to the 1990 census data (U.S. Bureau of the Census 1994) in which Benton County had 112,560 individuals and Franklin County had 37,473 individuals, the population totals reflect continued growth. The populations in Benton and Franklin Counties increased by 3,000 and 200, respectively, in 1997.

The 1997 estimates distributed the Tri-Cities' population within each city as follows: Richland 36,500, Pasco 25,300, and Kennewick 49,090. The combined populations of Benton City, Prosser, and West Richland totaled 13,905 in 1997. The unincorporated population of Benton County was 34,555. In Franklin County, incorporated areas (cities and towns) other than Pasco have a total population of 3,385. The unincorporated rural population of Franklin County was 15,215 (Washington State Office of Financial Management 1997a), and the number of people in incorporated areas other than Pasco was 3,385.

The 1997 estimates of racial/ethnic distribution (Washington State Office of Financial Management 1997a) indicate that Asians represent a lower proportion and individuals of Hispanic origin represent a higher proportion of the population in Benton and Franklin Counties than those in Washington State.

At the time of the 1990 census (U.S. Bureau of Census 1994), Hispanics accounted for nearly 81% of the minority population around the Hanford Site. The site is also surrounded by a relatively large percentage (approximately 8%) of Native Americans.

Benton and Franklin Counties account for 2.4% of Washington State's population (Washington State Office of Financial Management 1997b). In 1997, the population demographics of Benton and Franklin Counties were quite similar to those found within Washington State. The population in Benton and Franklin Counties under the age of 35 was 54.1%, compared to 50.3% for the state. In general, the population of Benton and Franklin Counties was somewhat younger than that of the state. The 0- to 14-year-old age group accounted for 26.5% of the total biconity population, compared to 22.6% for the state. In 1997, the 65-year-old and older age group constituted 9.6% of the population of Benton and Franklin Counties, compared to 11.5% for the state.

### 1.0.1.1 Site Description

The entire Hanford Site was designated a National Environmental Research Park (one of four nationally) by the former U.S. Energy Research and Development Administration, a precursor to the U.S. Department of Energy (DOE).

The major areas on the site include the following:

- The 100 Areas, on the south shore of the Columbia River, are the sites of nine retired plutonium-production reactors, including the dual-purpose N Reactor. The 100 Areas occupy approximately 11 km<sup>2</sup> (4 mi<sup>2</sup>).
- The 200-West and 200-East Areas are located on a plateau and are approximately 8 and 11 km (5 and 7 mi), respectively, south of the Columbia River. The 200 Areas cover approximately 16 km<sup>2</sup> (6 mi<sup>2</sup>).
- The 300 Area is located just north of the city of Richland. This area covers 1.5 km<sup>2</sup> (0.6 mi<sup>2</sup>).
- The 400 Area is approximately 8 km (5 mi) northwest of the 300 Area.



- The 600 Area includes all of the Hanford Site not occupied by the 100, 200, 300, and 400 Areas.
- The former 311-ha (768-acre) 1100 Area is located generally between the 300 Area and the city of Richland and included site support services such as general stores and transportation maintenance. On October 1, 1998, this area was transferred to the Port of Benton as a part of economic diversification efforts and is no longer part of the Hanford Site. However, DOE contractors continue to lease facilities in this area.
- The Richland North Area (off the site) includes the DOE and its contractor facilities, mostly leased office buildings, generally located in the northern part of the city of Richland.

Other facilities (office buildings) are located in the Richland Central Area (located south of Saint Street and Highway 240 and north of the Yakima River), the Richland South Area (located between the Yakima River and Kennewick), and the Kennewick/Pasco area.

Several areas of the site, totaling 665 km<sup>2</sup> (257 mi<sup>2</sup>), have special designations. These include the Fitzner/Eberhardt Arid Lands Ecology Reserve (310 km<sup>2</sup> [120 mi<sup>2</sup>]), the U.S. Fish and Wildlife Service Saddle Mountain National Wildlife Refuge (approximately 130 km<sup>2</sup> [50 mi<sup>2</sup>]), and the Washington State Department of Fish and Wildlife Reserve Area (Wahluke Slope Wildlife Recreation Area) (225 km<sup>2</sup> [87 mi<sup>2</sup>]). The Fitzner/Eberhardt Arid Lands Ecology Reserve was established in 1967 by the U.S. Atomic Energy Commission, a precursor to DOE, to preserve shrub-steppe habitat and vegetation. In 1971, the reserve was classified a Research Natural Area as a result of a federal interagency cooperative agreement. In June 1997, DOE transferred management, including access management, of the reserve from Pacific Northwest National Laboratory to the U.S. Fish and Wildlife Service, who will continue to operate the reserve using the in-place management policy (PNL-8506) until a new management plan can be written. This is scheduled to occur within 3 years of the June 1997 transfer date.

Secretary of Energy Bill Richardson announced in April 1999 a proposal to manage the entire Wahluke Slope area as a national wildlife refuge. Because the Washington State Department of Fish and Wildlife expressed an interest in withdrawing from management of the Wahluke Slope Wildlife Recreation Area, the recreation area and the Saddle Mountain National Wildlife Refuge would be combined and managed by the U.S. Fish and Wildlife Service for the DOE. The Wahluke Slope is a prime example of a shrub-steppe habitat that is quickly disappearing in the Pacific Northwest. This land has served as a safety and security buffer zone for Hanford operations since 1943, resulting in an ecosystem that has been relatively untouched.

Non-DOE operations and activities on Hanford Site leased land or in leased facilities include commercial power production by Energy Northwest (formerly known as the Washington Public Power Supply System) (WNP-2 reactor) (4.4 km<sup>2</sup> [1.6 mi<sup>2</sup>]) and operation of a commercial low-level radioactive waste burial site by US Ecology, Inc. (0.4 km<sup>2</sup> [0.2 mi<sup>2</sup>]). Kaiser Aluminum and Chemical Corporation is leasing the 313 Building in the 300 Area to use an extrusion press that was formerly DOE owned. The National Science Foundation has built the Laser Interferometer Gravitational-Wave Observatory facility near Rattlesnake Mountain for gravitational wave studies. R. H. Smith Distributing operates vehicle-fueling stations in the former 1100 Area and 200 Areas. Washington State University at Tri-Cities operates three laboratories in the 300 Area. Livingston Rebuild Center, Inc. has leased the 1171 Building, in the former 1100 Area, to rebuild train locomotives. Johnson Controls, Inc. operates 42 diesel- and natural gas-fueled package boilers for producing steam in the 200 and 300 Areas (replacing the old coal-fired steam plants) and also has compressors supplying compressed air to the site. Immediately adjacent to the southern boundary of the Hanford Site, Siemens Power Corporation operates a commercial nuclear fuel fabrication facility and



Allied Technology Group Corporation operates a low-level radioactive waste decontamination, super compaction, and packaging facility.

Much of the above information is from PNNL-6415, Rev. 10, where more detailed information can be found.

## 1.0.2 Historical Site Operations

This section addresses what, until recently, was the historic operational mission of the Hanford Site. However, with the advent of waste treatment and disposal technologies and environmental management, this mission has been replaced by cleanup. Section 1.0.3, “Current Site Mission,” Section 1.0.5, “Major Site Activities,” and Section 2.3, “Activities, Accomplishments, and Issues,” summarize current activities at the Hanford Site.

The Hanford Site was established in 1943 to use technology developed at the University of Chicago and the Clinton Laboratory in Oak Ridge, Tennessee to produce plutonium for some of the nuclear weapons tested and used in World War II. Hanford was the first plutonium production facility in the world. The site was selected by the U.S. Army Corps of Engineers because it was remote from major populated areas and had 1) ample electrical power from Grand Coulee Dam, 2) a functional railroad, 3) clean water from the nearby Columbia River, and 4) sand and gravel that could be used for constructing large concrete structures. For security, safety, and functional reasons, the site was divided into numbered areas (see Figure 1.0.1).

Hanford Site operations have resulted in the production of liquid, solid, and gaseous wastes. Most wastes resulting from site operations have had at least the potential to contain radioactive materials. From an operational standpoint, radioactive wastes were originally categorized (see Table 10.3 in Fitzgerald 1970) as “high level,” “intermediate level,” or “low level,” which referred to the level of radioactivity present. Some high-level solid waste, such as large pieces of machinery and equipment, were placed onto railroad flatcars and stored in underground

tunnels. Both intermediate- and low-level solid wastes, consisting of tools, machinery, paper, wood, etc., were placed into covered trenches at storage and disposal sites known as “burial grounds.” Beginning in 1970, solid wastes were segregated according to the makeup of the waste material. Solids contaminated with plutonium and other transuranic materials were packaged in special containers and stored in trenches covered with soil for possible later retrieval. High-level liquid wastes were stored in large underground tanks. Intermediate-level liquid waste streams were usually routed to underground structures of various types called “cribs.” Occasionally, trenches were filled with the liquid waste and then covered with soil after the waste had soaked into the ground. Low-level liquid waste streams were usually routed to surface impoundments (ditches and ponds). Nonradioactive solid wastes were usually burned in “burning grounds.” This practice was discontinued in the late 1960s in response to the Clean Air Act, and the materials were buried at sanitary landfill sites. These storage and disposal sites, with the exception of high-level waste tanks, are now designated as “active” or “inactive” waste sites, depending on whether the site is receiving wastes.

All unrestricted discharges of radioactive liquid wastes to the ground were discontinued in 1997. The 616-A crib (also known as the State-Approved Land Disposal Site) receives radioactive (tritium) liquid waste from the 200 Areas Effluent Treatment Facility. This effluent is the only discharge of radioactive liquid wastes to the ground at Hanford. All other liquids discharged to the ground are licensed by permit from the state of Washington. National Pollutant Discharge Elimination System permits issued by the U.S. Environmental Protection Agency



govern liquid discharges to the Columbia River (Title 40, Code of Federal Regulations, Part 122). Permits from the U.S. Environmental Protection Agency and the Washington State Department of Health govern the discharge of gaseous effluents to the atmosphere. See Section 2.2, “Compliance Status,” for details. The status of the high-level waste tanks is discussed in Section 2.3.8, “Tank Waste Remediation System Activities.”

### 1.0.2.1 The 300 Area

From the early 1940s until the advent of the cleanup mission, most research and development activities at the Hanford Site were carried out in the 300 Area, located just north of Richland. The 300 Area was also the location of nuclear fuel fabrication. Nuclear fuel in the form of pipe-like cylinders (fuel elements) was fabricated from metallic uranium shipped in from offsite production facilities. Metallic uranium was extruded into the proper shape and encapsulated in aluminum or zirconium cladding. Copper was an important material used in the extrusion process, and substantial amounts of copper, uranium, and other heavy metals ended up in 300 Area liquid waste streams. Initially, these streams were routed to the 300 Area waste ponds, which were located near the Columbia River shoreline. In more recent times, the low-level liquid wastes were sent to process trenches or shipped to a solar evaporation facility in the 100-H Area (183-H Solar Evaporation Basins). This practice has been discontinued. At this time, all liquid process wastes generated in the 300 Area are sent to the 300 Area Treated Effluent Disposal Facility for treatment and release to the Columbia River according to the requirements of a National Pollutant Discharge Elimination System permit. Sewage wastes are released into the city of Richland sanitary water treatment system.

Former fuel fabrication buildings and facilities are now used for other purposes or are in various stages of cleanup or restoration. For example, the 313 Building that houses a very large and unique

aluminum extrusion press is leased by DOE to Kaiser Aluminum and Chemical Corporation.

### 1.0.2.2 The 100 Areas

The fabricated fuel elements were shipped by rail from the 300 Area to the 100 Areas. The 100 Areas are located on the Columbia River shoreline, where up to nine nuclear reactors were in operation (Section 6.1, “Hanford Groundwater Monitoring Project,” discusses these operations). The main component of the nuclear reactors consisted of a large stack (pile) of graphite blocks that had tubes and pipes running through it. The tubes were receptacles for the fuel elements while the pipes carried water to cool the graphite pile. Placing large numbers of slightly radioactive uranium fuel elements into the reactor piles created an intense radiation field and a radioactive chain reaction resulted in the conversion of some uranium atoms into plutonium atoms. Other uranium atoms were split into radioactive “fission products.” The intense radiation field also caused some nonradioactive atoms in the structure to become radioactive “activation products.”

The first eight reactors, constructed between 1944 and 1955, used water from the Columbia River for direct cooling. Large quantities of water were pumped through the reactor piles and discharged back into the river. The discharged cooling water contained primarily activation products from impurities in the river water made radioactive by neutron activation and radioactive materials that escaped from the fuel elements, tube walls, etc. during the irradiation process. The ninth reactor, N Reactor, was completed in 1963 and was of a modified design. Purified water was recirculated through the reactor core in a closed-loop cooling system. Beginning in 1966, the heat from the closed-loop system was used to produce steam that was sold to Energy Northwest (formerly known as the Washington Public Power Supply System) to generate electricity at the adjacent Hanford Generating Plant.



When fresh fuel elements were pushed into the front face of a reactor's graphite pile, irradiated fuel elements were forced out the rear into a deep pool of water called a "fuel storage basin." After a brief period of storage in the basin, the irradiated fuel was shipped to the 200 Areas for processing. The fuel was shipped in casks by rail in specially constructed railcars. Most of the irradiated fuel produced by the N Reactor from the early 1970s to the early 1980s was the result of electricity production runs. This material was not weapons grade, so was never processed for recovery of plutonium.

Beginning in 1975, N Reactor irradiated fuel was shipped to the K-East and K-West Fuel Storage Basins (K Basins) for temporary storage, where it remains today. This fuel accounts for the majority of the total fuel inventory stored under water in the K Basins. From the early 1980s until its shutdown in 1987, N Reactor operated to produce weapons-grade material. Electricity production continued during this operating period but was actually a byproduct of the weapons production program. The majority of weapons-grade material produced during these runs was processed in the 200-East Area at the Plutonium-Uranium Extraction Plant prior to its shutdown. The remainder is stored in the K Basins. See Section 2.3.4, "Spent Nuclear Fuel Project," for the status and details regarding the storage of spent fuel.

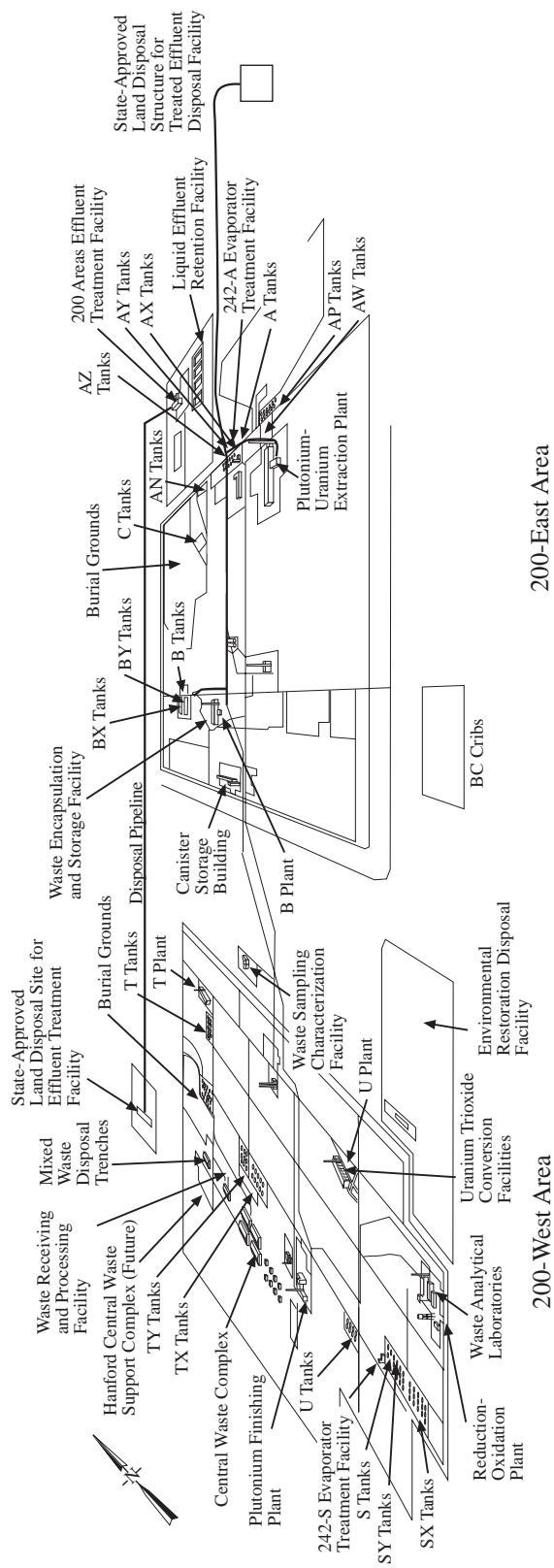
All of the Hanford production reactors and most of the associated facilities have been shut down and deactivated, and each 100 Area is in some stage of cleanup, decommissioning, or restoration. For example, C Reactor has been cocooned and placed into interim safe storage as a large-scale demonstration, a state that it can safely remain in for many years. Of the 24 facilities associated with the reactor, 23 have been removed. See Section 1.0.5.4, "Environmental Restoration," and Section 2.3, "Activities, Accomplishments, and Issues," for the status of various facilities.

### 1.0.2.3 The 200 Areas

The 200-East and 200-West Areas are located on a plateau approximately in the center of the site. These areas house facilities that received and dissolved irradiated fuel and then separated out the valuable plutonium (Figure 1.0.2). These facilities were called "separations plants." Three types of separations plants were used over the years to process irradiated fuel. Each of the plutonium production processes began with the dissolution of the aluminum or zirconium cladding material in solutions containing ammonium hydroxide/ammonium nitrate/ammonium fluoride followed by the dissolution of the irradiated fuel elements in nitric acid. All three separations plants, therefore, produced large quantities of waste nitric acid solutions that contained high levels of radioactive materials. These wastes were neutralized and stored in large underground tanks. Fumes from the dissolution of cladding and fuel and from other plant processes were discharged to the atmosphere from tall smokestacks. Filters were added to the stacks after 1950.

Both B and T Plants used a "bismuth phosphate" process to precipitate and separate plutonium from acid solutions during the early days of site operations. Leftover uranium and high-level waste products were not separated and were stored together in large, underground, "single-shell" tanks (i.e., tanks constructed with a single wall of steel). The leftover uranium was later salvaged, purified into uranium oxide powder at the Uranium-TriOxide Plant, and transported to uranium production facilities in other parts of the country for reuse. The salvage process used a solvent extraction technique that resulted in radioactive liquid waste that was discharged to the soil in covered trenches at the BC Cribs area south of the 200-East Area.

After T Plant stopped functioning as a separations facility, it was converted to a decontamination operation, where pieces of equipment and machinery could be radiologically decontaminated for reuse.



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**Figure 1.0.2. Waste Processing, Storage, and Disposal Facilities in the 200 Areas**



B Plant was later converted into a facility to separate radioactive strontium and cesium from high-level waste. The strontium and cesium were then concentrated into a solid salt material, melted, and encapsulated at the adjacent encapsulation facility. Canisters of encapsulated strontium and cesium were stored in a water storage basin at the encapsulation facility, where many remain today.

In 1952, U Plant in the 200-West Area, built during World War II but not needed as a processing canyon, was retrofitted as the Metal Recovery Plant. Its mission was to use a new tributyl phosphate/saturated kerosene extraction technique to recover uranium from the waste stored in Hanford's tank farms. The scarcity of high-grade uranium supplies made this mission crucial and much of the United States' supply of uranium was housed in Hanford's tanks. The separated uranium was purified into uranium oxide powder at the Uranium-TriOxide Plant.

The Reduction-Oxidation and Plutonium-Uranium Extraction Plants used solvent extraction techniques to separate plutonium from leftover uranium and radioactive waste products. Most of the irradiated fuel produced at the site was processed at either of these two plants. The solvent extraction method separates chemicals based on their differing solubilities in water and organic solvents (i.e., hexone at the Reduction-Oxidation Plant and tributyl-phosphate at the Plutonium-Uranium Extraction Plant). High-level liquid wastes were neutralized and stored in single-shell tanks (Reduction-Oxidation Plant) or double-shell tanks (Plutonium-Uranium Extraction Plant). Occasionally, organic materials such as solvents and resins ended up in high-level liquid waste streams sent to the tanks. Various chemicals and radioactive materials precipitated and settled to the bottom of the tanks. This phenomenon was later used to advantage. The liquid waste was heated in special facilities (evaporators) to remove excess water and concentrate the waste into salt cake and

sludge, which remained in the tanks. The evaporated and condensed water contained radioactive tritium and was discharged to cribs. Intermediate- and low-level liquid wastes discharged to the soil from the Reduction-Oxidation and Plutonium-Uranium Extraction Plants typically contained tritium and other radioactive fission products as well as nonradioactive nitrate. Intermediate-level liquid wastes discharged to cribs from the Reduction-Oxidation Plant sometimes contained hexone used in the reduction-oxidation process. Cooling water from the Reduction-Oxidation Plant was discharged to the 216-S-10 Pond. Cooling water from the Plutonium-Uranium Extraction Plant was discharged to the Gable Mountain and 216-B-3 Ponds.

The Reduction-Oxidation and Plutonium-Uranium Extraction Plants produced uranium nitrate for recycle and plutonium nitrate for weapons component production. Uranium nitrate was shipped by tank truck to the Uranium-TriOxide Plant for processing. The Uranium-TriOxide Plant used specially designed machinery to heat the uranium nitrate solution and boil off the nitric acid, which was recovered and recycled to the separations plants. The product (uranium oxide) was packaged and shipped to other facilities in the United States for recycle. Plutonium nitrate, in small quantities for safety reasons, was placed into special shipping containers (P-R cans) and hauled by truck to Z Plant (later called the Plutonium Finishing Plant) for further processing.

The purpose of Plutonium Finishing Plant operations was to convert the plutonium nitrate into plutonium metal blanks (buttons) that were shipped off the site for manufacture into nuclear components. The conversion processes used nitric acid, hydrofluoric acid, carbon tetrachloride, and other organic compounds. Varying amounts of all these materials ended up in the intermediate-level liquid wastes that were discharged to cribs. Cooling water from the Plutonium Finishing Plant was discharged via open



ditch to the 216-U-10 Pond. High-level solid wastes containing plutonium scraps were segregated and packaged for storage in special earth-covered trenches.

All of the former activities in the separations plants, the Reduction-Oxidation Plant, and the Plutonium Finishing Plant have been shut down and the facilities are in various stages of decontamination and decommissioning or alternate use. For example, the former T Plant complex now consists of two operational facilities used for waste sampling and verification, waste repackaging, equipment decontamination, and storage of a small amount of irradiated fuel from the former Shippingport, Pennsylvania reactor. See Section 1.0.5.3, "Facility Stabilization," Section 1.0.5.4, "Environmental Restoration," and Section 2.3.5, "Facility Stabilization Project," for additional information. Low-level and intermediate-level liquid wastes are no longer released to surface ponds, ditches, or cribs. These facilities are in various states of decommissioning, decontamination, and restoration. See Section 1.0.5.1, "Waste Management," and Section 2.2, "Compliance Status" (especially Table 2.2.2), for details.

#### 1.0.2.4 The 400 Area

In addition to research and development activities in the 300 Area, the Hanford Site has supported several test facilities. The largest is the Fast Flux Test

Facility, located approximately 8 km (5 mi) northwest of the 300 Area. This special nuclear reactor was designed to test various types of nuclear fuel. The facility operated for approximately 13 yr and was shut down in 1993. The reactor was a unique design that used liquid metal sodium as the primary coolant. The heated liquid sodium was cooled with atmospheric air in heat exchangers. Spent fuel from the facility resides in the 400 Area, while other wastes were transported to the 200 Areas. With the exception of the spent fuel, no major amounts of radioactive wastes were stored or disposed of at the Fast Flux Test Facility site. In January 1997, DOE made a decision to keep the Fast Flux Test Facility in standby while evaluating its potential for tritium and medical isotope production, as well as plutonium disposition. Tritium, a necessary ingredient in some nuclear weapons, decays relatively quickly so must be replenished. Medical isotopes are radioactive elements that are useful for the treatment of medical conditions such as cancer. Excess plutonium, no longer needed for national defense, could be disposed of by converting it to reactor fuel that could be burned in commercial reactors. Decisions were made in 1998 to not use the Fast Flux Test Facility for tritium production or plutonium disposition. A decision on any civilian missions for the facility, such as medical isotope production, is expected in 1999. Details can be found in Section 2.3.6, "Fast Flux Test Facility."

### 1.0.3 Current Site Mission

For more than 40 years, Hanford Site facilities were dedicated primarily to the production of plutonium for national defense and to the management of the resulting wastes. In recent years, efforts at the site have focused on developing new waste treatment and disposal technologies and cleaning up contamination left over from historical operations.

Site activities include two major missions: 1) environmental management and 2) science and

technology. The environmental management mission includes the following:

- **management of wastes** and the handling, storage, treatment, and disposal of radioactive, hazardous, mixed, or sanitary wastes from past and current operations
- **stabilizing facilities** by transitioning them from an operating mode to a long-term surveillance and maintenance mode. This includes maintaining facilities in a safe and compliant status, deactivating primary systems to effectively reduce risks, providing



for the safe storage of nuclear materials and reducing risks from hazardous materials and contamination. These activities are intended to allow the lowest surveillance and maintenance cost to be attained while awaiting determination of a facility's final disposition.

- **maintaining the Fast Flux Test Facility reactor** and its associated support facilities while alternative future missions for the reactor are explored (e.g., medical isotope production)
- **maintenance and cleanup** of several hundred inactive radioactive, hazardous, and mixed waste disposal sites; **remediation** of contaminated groundwater; and **surveillance, maintenance, and decommissioning** of inactive facilities.

The science and technology mission includes the following:

- **research and development** in energy, health, safety, environmental sciences, molecular sciences, environmental restoration, waste management, and national security
- **developing new technologies** for environmental restoration and waste management, including site characterization and assessment methods; waste minimization, treatment, and remediation technology.

DOE has set a goal of cleaning up Hanford's waste sites and ensuring that its facilities are always in compliance with federal, state, and local environmental laws. In addition to supporting the environmental management mission, DOE is also supporting other special initiatives in accomplishing its national objective.

The highest priority of the DOE Richland Operations Office is to achieve daily excellence in protection of the worker and the public and in stewardship of the environment, both on and off the Hanford Site. By meeting the most rigorous standards, the DOE Richland Operations Office provides safe and healthful workplaces and protects the environment of all Richland Operations' activities. Fundamental to the attainment of this policy are personal commitment and accountability, mutual trust, open communications, continuous improvement, worker involvement, and full participation of all interested parties. Consistent with the strategic plan for the site (DOE/RL-96-92), the Richland Operations Office will reduce accidents, radiological and toxicological exposures, and regulatory noncompliances.

## 1.O.4 Site Management

Hanford Site operations and activities are managed by the DOE Richland Operations Office through the following contractors and subcontractors. Each contractor is responsible for safe, environmentally sound maintenance and management of its activities or facilities; for waste management; and for monitoring its activities and any potential effluents to ensure environmental compliance.

The principal contractors and their respective responsibilities include the following:

- Fluor Daniel Hanford, Inc., the management and integration contractor, is the prime contractor under the Project Hanford Management Contract awarded in 1996. The Project Hanford Management

Contract encompasses the majority of the work under way at the Hanford Site as it relates to DOE's mission to clean up the site. Major subcontractors of Fluor Daniel Hanford, Inc. and their areas of responsibility are as follows.

- Lockheed Martin Hanford Corporation—responsible for safely managing the underground waste containment tanks and for tank waste remediation systems. With 177 underground waste containment tanks at the site, they are evaluating tank contents, treatment alternatives, retrieval alternatives, and closure alternatives.
- Waste Management Federal Services of Hanford, Inc.—responsible for waste management.



They use existing technology to accelerate treatment and disposal of waste, reduce the need for waste storage, and minimize waste disposition.

- Fluor Daniel Hanford Inc./DE&S Hanford, Inc.—responsible for the Spent Nuclear Fuel Project. This project addresses the cleanup efforts associated with the waste and fuel rods stored in the K Basins.
- B&W Hanford Company—responsible for the facility stabilization project and the Advanced Reactors Transition Project. The facility stabilization project is tasked with safely and cost effectively deactivating contaminated surplus facilities to a reduced cost, low-risk stabilized/shutdown condition for either long-term surveillance and maintenance or final disposition. The Advanced Reactors Transition Project maintains the Fast Flux Test Facility and its associated support facilities in a safe and stable condition while DOE explores alternative future missions.
- Numatec Hanford Corporation—responsible for technology implementation and nuclear engineering. They provide application technology as needed to all cleanup contractors.
- DynCorp Tri-Cities Services, Inc.—responsible for infrastructure services. They provide non-nuclear-related support in the areas of site operation, property management, utilities, facility maintenance, site services, and emergency preparedness.
- Protection Technology Hanford (B&W Protec, Inc. through February 1999)—provides safeguard and security services, including material control and accountability, physical security, information security, and other security activities.
- Battelle Memorial Institute operates Pacific Northwest National Laboratory, the research and development contractor, for DOE, conducting research and development in environmental restoration and waste management, environmental science, molecular science, energy, health and safety, and national security. In addition, the laboratory performs

groundwater monitoring for the Hanford Groundwater Monitoring Project, which includes Resource Conservation and Recovery Act/Comprehensive Environmental Response, Compensation, and Liability Act monitoring, and surface environment surveillance, both on and around the site for the Surface Environmental Surveillance Project.

- Bechtel Hanford, Inc., the environmental restoration contractor, is responsible for surveillance and maintenance of inactive past-practice waste sites and inactive facilities; characterization and remediation of past-practice waste sites and contaminated groundwater; management of remediation waste; closure of Resource Conservation and Recovery Act land-based treatment, storage, and disposal units; decontamination and decommissioning of facilities; overall Hanford Site groundwater project management; site-wide drilling management; and coordinating and integrating work that could impact water resources through the Hanford Site Groundwater/Vadose Zone Integration Project. The Bechtel Team includes two preselected subcontractors: CH2M Hill Hanford, Inc. and ThermoHanford, Inc.
- Hanford Environmental Health Foundation is the occupational and environmental health services contractor.
- MACTEC-ERS is a prime contractor to the DOE Grand Junction Office and is performing vadose zone characterization and monitoring work beneath single-shell underground waste storage tanks in the 200 Areas.

In addition, several enterprise companies were created to provide services to Fluor Daniel Hanford, Inc. These subcontractors and their areas of responsibility include the following:

- COGEMA Engineering Corporation provides engineering and technical support in the areas of tank waste remediation systems engineering and construction, spent fuel conditioning, and engineering testing and technology.
- Lockheed Martin Services, Inc. provides telecommunications and network engineers, information systems, production computing, document control, records management, and multimedia services.



- Fluor Daniel Northwest, Inc. provides a variety of professional services to the subcontractors, including construction, engineering, finance, accounting, and materials management.
- DE&S Northwest, Inc. provided nuclear and non-nuclear services in the area of quality assurance and related activities through the end of calendar year 1998.
- Waste Management Federal Services, Inc., Northwest Operations provides waste transportation services, waste packaging systems engineering, environmental monitoring and investigations,

groundwater well services, sampling and mobile laboratory services, and nuisance wildlife and vegetation management.

British Nuclear Fuels Limited, Inc. was authorized by DOE in 1998 to proceed with their contract to provide services to treat and immobilize an initial portion of Hanford's radioactive underground tank wastes. The proof of concept, commercial demonstration phase will cover a 10- to 14-yr period, after which a full-scale production phase may be authorized.

## 1.0.5 Major Site Activities

### 1.0.5.1 Waste Management

Current activities at the site include the management of high- and low-level defense wastes in the 200-East and 200-West Areas (see Figure 1.0.2) and the storage of irradiated fuel in the 100-K Area. Major facilities are discussed below.

Waste management activities involving single-shell and double-shell tanks include ensuring safe storage of wastes through surveillance and monitoring of the tanks, upgrading monitoring instrumentation, and imposing strict work controls during intrusive operations. Concerns had been raised about the potential for explosions from ferrocyanide and/or organic fuels or hydrogen gas accumulation in the waste tanks. DOE and external oversight groups have concluded that there is no imminent danger to the public from either situation. Details concerning these tank wastes are in Section 2.3.8, "Tank Waste Remediation System Activities."

Liquid wastes on the Hanford Site are managed in treatment, storage, and disposal facilities. Details on these facilities are provided in Section 2.3.10, "Liquid Effluent Activities."

Solid waste is received at the low-level burial grounds in the 200-East and 200-West Areas and the Central Waste Complex in the 200-West Area from

all radioactive waste generators on the site and any offsite generators authorized by DOE to ship waste to the Hanford Site for treatment, storage, and disposal. In addition, reactor compartments are being received from the United States Navy for disposal in a special trench in the 200-East Area. The Waste Receiving and Processing Facility (operations began in March 1997) has the capability to process retrieved, suspect, transuranic, solid waste (waste that may or may not meet transuranic criteria); certify newly generated and stored transuranic solid and low-level wastes for disposal at the Waste Isolation Pilot Plant in New Mexico (transuranic only) or the low-level burial grounds (low-level waste only); and process small quantities of radioactive mixed low-level waste for permanent disposal. Details on these and other facilities for the management of solid waste are provided in Section 2.3.9, "Solid Waste Management Activities."

The Environmental Restoration Disposal Facility, near the 200-West Area, was opened in July 1996 to accept waste generated during the Hanford Site cleanup activities. This facility serves as the central disposal site for contaminated soil and other waste removed under the Environmental Restoration Program. Additional details about this facility are provided in Section 2.3.12.1, "Environmental Restoration Disposal Facility."



### **1.0.5.2 Spent Nuclear Fuels Project**

The Spent Nuclear Fuels Project supports the Hanford mission to clean up the site by managing and reducing hazards associated with its spent nuclear fuel inventory. Spent nuclear fuel stored on the site varies in condition and level of vulnerability and is stored in both wet and dry configurations. Potential risks to workers, assurance of public health and safety, and protection of the environment led to a decision to proceed immediately with the removal of spent nuclear fuel stored in the K Basins. Refer to Section 2.3.4, “Spent Nuclear Fuel Project,” for further details.

### **1.0.5.3 Facility Stabilization**

The Facility Stabilization Project’s mission is to transition those Hanford Site facilities, for which it has responsibility, from an operating mode to a long-term surveillance and maintenance mode. This includes maintaining facilities in a safe, compliant status; providing for the safe storage of nuclear materials; and reducing risks from hazardous materials and contamination. Under the project, the deactivation of primary systems to effectively reduce risks to human health and the environment will also be conducted. These activities will allow the lowest surveillance and maintenance costs to be attained while awaiting determination of a facility’s final disposition and possible turnover to the DOE Environmental Restoration Program.

The Facility Stabilization Project is engaged in five major deactivation efforts at the Hanford Site. The major efforts are B Plant, the Facility Stabilization and Environmental Restoration Team, the

300 Area Stabilization Project, the Waste Encapsulation and Storage Facility, and the Plutonium Finishing Plant. In addition, surveillance and maintenance of the Plutonium-Uranium Extraction Plant continued, following the completion of deactivation activities. The mission of each of these projects and related accomplishments during 1998 are provided in Section 2.3.5, “Facility Stabilization Project.”

### **1.0.5.4 Environmental Restoration**

The Environmental Restoration Project activities include decontamination and decommissioning of inactive facilities, surveillance and maintenance of deactivated facilities, transition of deactivated facilities and waste sites to the Environmental Restoration Program, characterization and cleanup of inactive waste sites, monitoring and remediation of contaminated groundwater, management of site-wide drilling, integrating groundwater and vadose zone activities that could impact water resources, and management of remediation waste. Refer to Section 2.3.12, “Environmental Restoration Project,” for details.

### **1.0.5.5 Research and Technology Development**

Research and technology development activities are conducted in the 200, 300, 400, and Richland North Areas. Many of these activities are intended to improve the techniques and reduce the costs of waste management, cleanup, environmental protection, and site restoration. Refer to Section 2.3.15, “Research and Technology Development Activities,” for details.



## 1.0.6 Site Environmental Programs

### 1.0.6.1 Effluent Monitoring, Waste Management, and Chemical Inventory Programs

Liquid and airborne effluents are monitored or managed through contractor effluent monitoring programs. These programs are designed to monitor effluents at their point of release into the environment whenever possible. Waste management and chemical inventory programs document and report the quantities and types of solid waste disposed of at the Hanford Site and the hazardous chemicals stored across the site. Results for the 1998 effluent monitoring and waste management and chemical inventory programs are summarized in Section 2.5, “Waste Management and Chemical Inventories,” and Section 3.1, “Facility Effluent Monitoring.”

### 1.0.6.2 Near-Facility Environmental Monitoring Program

This program provides facility-specific environmental monitoring immediately adjacent to onsite facilities. Monitoring is conducted to comply with DOE and contract requirements and local, state, and federal environmental regulations. The program is also designed to evaluate the effectiveness of effluent treatments and controls and waste management and restoration activities and to monitor emissions from diffuse/fugitive sources. Results for the 1998 programs are summarized in Section 3.2, “Near-Facility Environmental Monitoring.”

### 1.0.6.3 Sitewide Environmental Surveillance

The main focus of sitewide environmental surveillance is on assessing the impacts of radiological and chemical contaminants on the environment and human health and confirming compliance with pertinent federal and state environmental regulations

and policies. Surveillance activities are conducted both on and off the site to monitor for contaminants from the entire Hanford Site rather than from specific contractor-owned or -managed facilities. Results for the 1998 sitewide environmental surveillance program are summarized in Section 4.0, “Environmental Surveillance Information.”

### 1.0.6.4 Groundwater Monitoring and Vadose Zone Baseline Characterization

Extensive groundwater monitoring is conducted onsite to document the distribution and movement of groundwater contamination, to assess the movement of contamination into previously uncontaminated areas, to protect the unconfined aquifer from further contamination, and to provide an early warning when contamination of groundwater does occur. Sampling is also conducted to comply with federal and state requirements. A description of the monitoring program and a summary of the monitoring results for 1998 are described in Section 6.1, “Hanford Groundwater Monitoring Project.”

Vadose zone baseline characterization is being conducted to establish baseline levels of manmade radionuclides in the vadose zone beneath the single-shell tanks in the 200 Areas and beneath selected cribs and trenches used for waste disposal. The primary objective of these efforts is to detect and identify gamma-emitting radionuclides and determine their activities and distributions. Other significant vadose zone activities that occurred in 1998 include spectral gamma-ray logging of boreholes at past-practice liquid waste disposal facilities associated with the Plutonium Finishing Plant. Results for these vadose zone activities in 1998 are summarized in Section 6.2, “Vadose Zone Characterization and Monitoring.”



### 1.0.6.5 Other Environmental Programs

Other aspects of the environment are studied for reasons other than specific impacts from possible

contamination. These aspects include climate, wildlife, and cultural resources. These studies are summarized in Section 7.0, "Other Hanford Site Environmental Programs."

## 1.0.7 References

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